Field meeting with Al Kalin/Imperial County Farm Bureau

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FROM:

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On January 12, 2006, Vic Nguyen, Pamela Vanderbilt, and I joined Al Kalin for a field meeting around the southern end of the Salton Sea. The purpose of the field meeting was for Al to brief us on his experience and thinking regarding potential emissivity, reclamation, and stabilization of the Salton Sea playa.

For the purposes of these notes, the main areas we discussed during the day are divided among the following topics:

1. Emissivity of exposed playa
2. Using flows during early years to reclaim Salton Sea margins
3. Land uses of exposed areas
4. Vegetation of AQM areas
5. Irrigation and drainage on AQM areas

Additional notes from Pamela Vanderbilt are in Appendix A to this memo. Photos from the trip will follow separately.

Emissivity of exposed playa

During the course of the day, we visited a number of intermittently flooded areas around the southern end of the Sea. The surfaces ranged as follows:

1. Black alkali in evidence, intermittent patches of loose, puffy soil interspersed with smooth, thin salt crust. This was predominant along the northeastern reach of our tour, near the wildlife refuge.
2. White salt crusting with efflorescent salts. These were extremely common in areas recently flooded by the sea, such as beaches.
3. White salt crusting without efflorescent salts. This occurred at one site only.

The widespread occurrence of surface type (2) squares with Al's characterization of wintertime crust conditions he has observed around the sea, and the dust storms he has described and photographed. While salt emissions are significant, I suspect that over large areas, the largest proportion of emissions and largest storms would, if left to occur, likely be predominantly mineral soil erosion, such as we see at Owens Lake. Although efflorescent salts contribute to dust, there is so much more soil mass available below the soft, weak soil surfaces on which these blooms occur, that severe dust storm dust load quickly shifts away from efflorescent salts, which are blown up in the first puff of a big storm. The presence of these crusts is therefore not only significant for the presence of the fluffy salts, but also for the softened crust on which they are formed.

Note that when playas take on this condition seasonally, dust concentrations are still highest where sand is present to drive emissions. The general approach to controlling emissions is not different. However, in some cases, efflorescent salts may contribute to dust emissions where they would not otherwise occur. To eliminate efflorescent emissions may require more intensive control (e.g., denser vegetative cover, etc.). This may be justified at playa margins where playa is immediately adjacent to receptors.

The current approach, which acknowledges that a large proportion of the Sea bed may require active control, and containing contingencies to control the vast majority should this prove necessary, is consistent with seasonally soft crust conditions such as we observed on this trip. DRI testing at the month's end will include some of these sites, and should show substantial emissions rates.

Using flows during early years to reclaim Salton Sea margins

This is the idea of Al's that has the greatest impact on facilities planning in its early stages, and thus requiring immediate discussion with the infrastructure team if it is to be considered seriously. His own email has described the idea reasonably well. I'll make the main points here, as currently understood. With regard to feasibility, my take is that this approach could work extremely well where inflows are available and the Sea floor topography is gentle, saving money and increasing the value of the exposed lands.

The objective of reclamation is to remove salt from land before it is dewatered, so that plants will naturally establish, or be easily established by artificial means. Subsequent land uses for any given parcel might be AQM, or could be something else, like farming. Either AQM or farming would be facilitated by land reclamation.

Al proposes reclamation in the wet by construction of a temporary (10-20 years) dike in the Sea at the minimum depth in which a dredge can practically operate, or deeper. The landward side of the dike might contain some lateral dikes to facilitate management, and would

be supplied with surplus inflows and would eventually become fresh, with the saline Sea outboard. As the outboard Sea subsides, lateral drainage through sediments would be augmented by downward seepage and flushing. Along with substantial wave action and mixing of surface sediments, leaching and mixing would (in Al's view, and I think this is reasonable) gradually remove salinity from surface sediments within the diked area. Over time, and depending on the nature of local sediments, a proportion of the Sea floor inboard of the dike would gradually become freshened. When water levels inboard of the dike would eventually be lowered, emergent, wetland, and later upland vegetation could establish in succession. This process has long been used to "reclaim" sea floor for agricultural uses, most famously in Dutch polders. Although reclamation could also be achieved on the saline playa after the water is removed (as previously discussed for AQM), polders have some advantages where they can be practically employed.

Subsequent temporary dikes would be constructed in a similar manner, sea-ward of the first, as the Sea recedes. If sufficient water remained available for routing through this new set of polders, they could be reclaimed in a similar manner to the first set.

The approach could also be considered for adaptation to construction of lowland features (habitat) in the wet.

Potential advantages of polders include:

- Construction in the wet, altering, and likely reducing overall air quality issues.
- Replaces initial reclamation effort for exposed land.
- Land vegetated as water recedes, potentially by natural means, eliminating lag period when surfaces would be infertile and exposed.
- Exposed areas could be evaluated and allocated to land uses based on existing and evolving plans and needs.
- Exposed playa would not initially be saline, and if reclamation were maintained, would not become saline. This would eliminate both stable and unstable playa crusting, as well as efflorescent salt bloom on playa crusts.
- Opportunity to simplify irrigation and drainage infrastructure installed after land is exposed, since playa would not be maintained in a saline condition.

Potential disadvantages include:

- Demand for freshwater supply to empoldered area to reclaim lands (need to be located at times and places when flows are available for routing through the area)
- Time and effort required to empolder and reclaim lands within the polder (needs to be done early in the process before areas are exposed to have maximum benefit)
- Safety and requirement for construction and maintenance of outboard dike; potential liquefaction during seismic event (what would downgradient risks be?)
- Potential for mosquito breeding in freshwater (addressable with mosquitofish?)

- Potential interference with pupfish connectivity (addressable by maintaining adequate water depth in passages near shore?)
- Selenium build-up in the sediment (notes that Fig Lagoon has not presented a problem, although it has remained relatively fresh for some time)
- Cat-tails taking over (primarily a function of water depth and salinity, so should not be an issue in deeper areas)

Needs common to polders and reclamation of exposed playa:

- **Avoidance of unacceptable/non-mitigable ecological risk:** Potentially eco-toxic trace element conditions (concentrations, oxidation states, exposure, food chain) need to be anticipated, understood, and avoided. Given the nature and variability of Salton Sea ecosystem inflows, sediments, and biota, this potential can be substantial. Given the cost/feasibility issues associated with management of so much land and water, it would seem prudent to draft major engineering alternatives, and then to analyze ecorisk and build in mitigating modifications and features.
- **Need to maintain critical habitat and ecological conditions:** E.g., pupfish connectivity.
- **Reclamation maintenance:** For lowland applications (ag and AQM), although initial reclamation is different, long-term reclamation must be maintained by balancing irrigation+precipitation with ET+drainage such that shallow groundwater does not rise into the root zone. This may require installation of subsurface drainage or interceptor drains (as proposed by John Scott). Where irrigation loads are very low or soils are fairly permeable, then artificial drainage may not be necessary.
- **Irrigation:** If plant communities and/or densities supported by native hydrology are not adequate to achieve economic, biological, or land stability goals for an area, then additional water and a means to deliver it across the land surface will likely be required to sustain facilities after initial reclamation.

Land uses of exposed areas

As implied above, once land is reclaimed (salinity levels in the sediments reduced, and [for upland land uses such as ag and AQM] shallow groundwater drained from the sediments to allow plants to root), potential uses, and therefore value, would be much less restricted than for saline playa. It is Al's opinion, and in my view quite reasonable, that reclaimed playa would behave much like adjacent desert and farmland. That is, the soil formation history of what happens to be under water and what happens to be dry land today was similar up until about 100 years ago. The major difference imposed during this recent flooding and salinization (below -227 msl) and land management (above -227 msl) would be removed as the Sea recedes and the land is reclaimed.

Vegetation of AQM areas

Al pointed out that areas along the margin of the Sea that have been flushed by inflows are naturally vegetating. Plant species are a function of the residual and water supply salinity, soil texture and salinity, and water depth. He points out that the value of plants such as cattail for reclamation and from a habitat standpoint may be quite different. He also notes that, while tamarisk establishes in exposed areas, it can be suppressed where competing species establish first.

An ecosystem management plan that includes reclamation in the wet would also need to acknowledge the natural and desired processes of vegetation establishment, and endeavor to create conditions favorable to emergence of desired plant communities. Control of hydrology and salinity conditions as land transitions to its ultimate use provide a potentially cost effective means for controlling the quality of the plant community as it emerges. When costly propagation and planting are part of this process, then maintenance of favorable conditions for the success of new plants is all the more critical.

Irrigation and drainage on AQM areas

Irrigation and drainage technology for reclaimed lands can be viewed on existing farmlands nearby to the Salton Sea. Depending on the nature of the land and the crop, technology varies widely. However, surface irrigation and open drains predominate within IID.

Should the Sea floor be successfully reclaimed for upland land use, then a similarly variable set of soils, drainage (shallow groundwater), and plant community conditions, and therefore irrigation and drainage technology needs, should emerge. Soils beneath the Sea may also include features quite distinct from what have been terrestrial soils for hundreds of years. Examples include the presence of barnacle deposits, organic matter enrichment, elevated nutrient and selenium content, thick (and likely quite fertile) deltaic deposits, fine-textured shoreline deposits, and (in the lowest lying areas) extremely deep, heavy-textured soils.

When describing irrigation and drainage infrastructure and management for the exposed playa, this diversity needs to be clearly acknowledged. Due to the focus on rapid reclamation and vegetation of saline playa in the July draft of the AQM memo, criteria for irrigation and drainage system performance were far more stringent than would be the case for areas reclaimed in the wet before drainage. If this approach is accepted, then the AQM memo, and specifically the description of the range of irrigation and drainage technologies and plant communities that could be successfully employed, will be altered to reflect this change.

Appendix A

Salton Sea Site Visit with Al Kalin

January 12, 2006

Attended by John Dickey, Vic Nguyen, and Pamela Vanderbilt

In an email dated December 28, 2005, Al Kalin graciously offered to take us on a site visit "to see firsthand, the problems we will be facing as the sea recedes? A 4 hour tour of the south end of the Sea, including both river delta areas will show you what I am talking about. There are already naturally formed wetlands where the fresh drainwater has leached the salts from the soil and allowed cattails, phragmites, and bulrush to grow."

We visited an area just south of the southwest corner of the Wister Waterfowl Management Refuge. Entering the Wister Refuge, we drove south on Davis Road, and turned right on U-Lateral Road to a dead end in vegetation near the shore of the sea. Offshore here, Al reports that a natural barnacle shoal has impounded drain water to cover quite a large area. According to Al, the exposure to the fresher drain water and the wave action results in the soils in the area becoming less saline than other nearby soil, because cattails and other plants have grown in. GPS Coordinates: N 33° 14.946'. W 115° 35.345'.

While returning to the east along U-Lateral Road, we stopped to look at soil conditions in a nearby barren field. The field to the South of U-Lateral road had soft soil, with a brown bubbly surface, with some whitish crusting in between the brown bumps. The brown material and crust did not pass the Visible Crust Determination Test in ICAPCD Rule 800, Section B, hereafter referred to as the "ball bearing test".

We then traveled south to an area near the Geothermal plants operated by California Energy. We visited the location where Al had taken some of his photographs that he showed us in the January 11, 2006 Air Quality Working Group Meeting. We went through a gate that required a key, with a sign "Wildlife Viewing Area". We were looking West and slightly North at the IID Flood Control Dike at the Delta of the New River. In front of the Dike is an exposed crust area on the shoreline. Al photographed white dust clouds that formed off this exposed crust area as winds increased in speeds on December 23, 2004, and presented these pictures to us on January 11, 2006. Approximate GPS Coordinates of where we were standing: N 33° 07.394'. W 115° 40.104'. (near the blue dot on Al's slide). Al thought the crusts north of the road we were standing on, near the shoreline, would be similar to what he saw blowing. It should be possible to bring the Pi-Swerl on the shore here. We did not visit the exposed areas he saw blowing nearer the Dike, but the salt crust areas between the road we were on and the shoreline near us were very soft and puffy. The salt crust released white powder upon disturbance, and did not pass the "ball bearing test".

We visited the southwestern-most corner of the Salton Sea, on land Al thought was owned by the Fire Department (previously Benson's Landing, a boat dock area). This is where Al took the pictures looking back (east) at the IID Dike at the New River Delta, showing dusty exposed areas on the other side of the Dike. GPS Coordinates: N 33° 06.155'. W 115° 45.158'. Mike Morgan has reclaimed land that was very salty near this shore, and the reclaimed land now behaves much like other IID farm land. Salty crusted areas near here were also soft and puffy. The salt crust released white powder upon disturbance, and did not pass the "ball bearing test".

Al took the salt crust samples he brought to the Air Quality Working Group Meeting from exposed, salty, sandy soil near here. The samples came from an exposed area about 200 yards west (maybe more) of the site of the GPS coordinates, on land owned by Mike Morgan. The salty crusts here were harder overall than what we saw elsewhere, with much more salt adhesion to chunks of soil. Some areas on the salty surfaces were soft and puffy. This salt crust did not pass the "ball bearing test". Al thought this might be land that that Mike might be interested in reclaiming. This is a possible area to test use of Al's salt removal idea. Al will get Mike together with John Dickey to talk about a potential pilot test.